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**Biomass composition and lignin chemistry of energy sorghum**

Guiding future optimization of energy sorghum yields, composition, and resilience

**The Science**

Comprehensive information about bioenergy crops’ composition under field conditions is needed to design optimal systems for production, harvesting, storage, and biorefinery operations. In this study, GLBRC researchers used near-infrared spectroscopy and nuclear magnetic resonance spectroscopy to characterize the composition of the energy *Sorghum bicolor* hybrid TX08001 grown in irrigated and non-irrigated field conditions, providing baseline information for future optimization.

**The Impact**

Renewable, low-cost sources of plant-derived biomaterials could significantly enhance long-term food, energy, and environmental security. This study of sorghum grown under different field irrigation regimes provides a baseline of information to help guide further optimization of energy sorghum, including improving biomass yield, optimizing biomass composition, and increasing crop resilience.

**Summary**

This study was conducted to document the extent and basis of compositional variation of shoot biomass of the energy *Sorghum bicolor* hybrid TX08001 during development under field conditions. TX08001 is capable of accumulating ~40 Mg/ha of dry biomass under good growing conditions and this genotype allocates ~80% of its shoot biomass to stems. After 150 days of growth TX08001 stems had a fresh/dry weight ratio of ~3:1 and soluble biomass accounted for ~30% of stem biomass. A panel of diverse energy sorghum genotypes varied ~6-fold in the ratio of stem structural to soluble biomass after 150 days of growth. Near-infrared spectroscopic analysis (NIRS) showed that TX08001 leaves accumulated higher levels of protein, water extractives and ash compared to stems, which have higher sugar, cellulose, and lignin contents. TX08001 stem sucrose content varied during development, whereas the composition of TX08001 stem cell walls, which consisted of ~45-49% cellulose, ~27-30% xylan, and ~15-18% lignin, remained constant after 90 days post emergence until the end of the growing season (180 days). TX08001 and Della stem syringyl (S)/guaiacyl (G) (0.53-0.58) and ferulic acid (FA)/para-coumaric acid (pCA) ratios were similar whereas ratios of pCA/(S+G) differed between these genotypes. Additionally, an analysis of irrigated versus non-irrigated TX08001 revealed that non-irrigated hybrids exhibited a 50% reduction in total cell wall biomass, an ~2-fold increase in stem sugars, and an ~25% increase in water extractives relative to irrigated hybrids. This study provides a baseline of information to help guide further optimization of energy sorghum composition for various end-uses.

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**Publications**

McKinley, B. A. *et al.* “Variation in energy sorghum hybrid TX08001 biomass composition and lignin chemistry during development under irrigated and non-irrigated field conditions.” *PLOS ONE* **13(4)**, e0195863 (2018) [DOI: 10.1371/journal.pone.0195863].

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